

RELIABILITY CENTERED MAINTENANCE

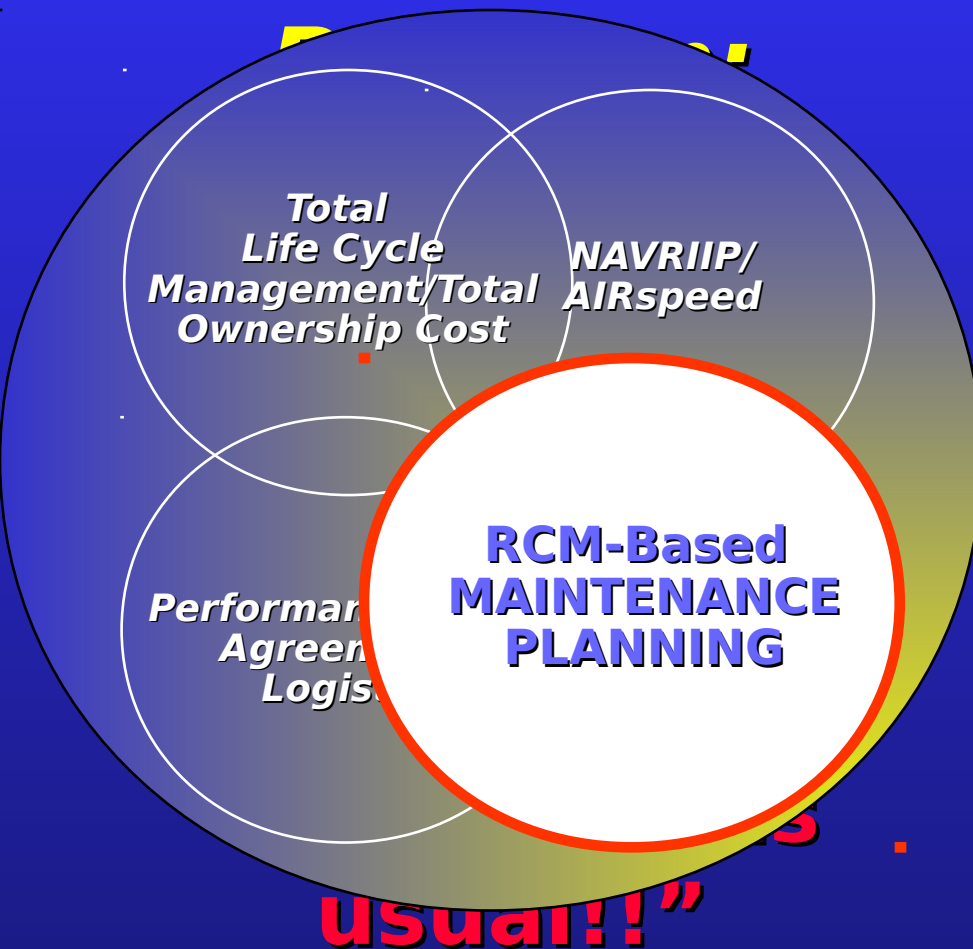
Management Overview

NAVAIR RCM
<http://logistics.navair.navy.mil/rcm>

Objective

To promote an understanding of Reliability-Centered Maintenance concepts, the NAVAIR RCM Program, and the associated analysis processes to enable effective implementation and sustainment and ensure safety and Cost-Wise Readiness

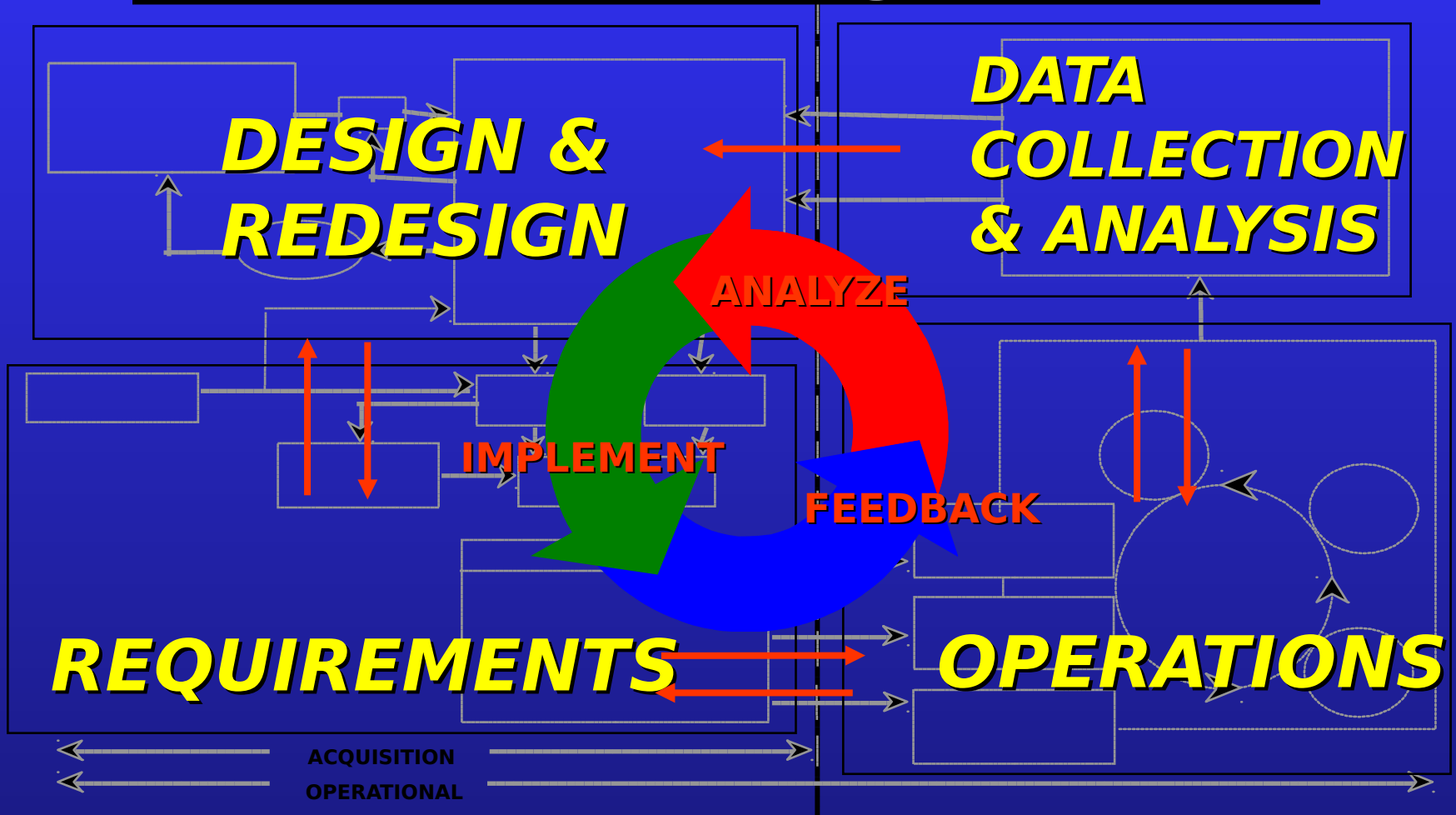
Cost-Wise Readiness



RCM

Used to **sustain Maintenance Planning throughout the Life Cycle** to ensure safety and achieve Cost-Wise Readiness

RCM-based Maintenance Planning



Introduction to RCM

What is RCM?

RCM Defined

Reliability-Centered Maintenance (RCM)

An analytical process to determine the appropriate failure management strategies to ensure safe operations and cost-wise readiness

Failure Management strategies:

- **Preventive Maintenance (PM) requirements**
- **Other actions**
- **Run to failure**

Introduction to RCM

What is RCM?

RCM Defined

How do you do it?

This process, with an auditable documentation package, is based on the reliability of the various components, the severity of the consequences related to safety and mission if failure occurs, and the cost effectiveness of the task

Introduction to RCM

What is RCM?

RCM Defined

➤ **Goal of RCM**

- ✓ Avoid or reduce failure **Consequences**
- ✓ Not necessarily to avoid failures

➤ ***Failure Consequences are the effects of failure on:***

- ✓ Personal and Equipment **Safety**
- ✓ **Environmental** Health/Compliance
- ✓ **Operations**
- ✓ **Economics**

Along with the evidence of failure - **Hidden** or **Evident**

Types of Maintenance/ Terminology

RCM determines proper balance of planned and unplanned maintenance, along with “Other Actions”, to establish a “Failure Management Strategy”

Preventive Maintenance
Scheduled Maintenance
Proactive Maintenance

Condition Based Maintenance
Condition Monitoring
Predictive Maintenance
Prognosis Health Management (PHM)
Potential failures

Preserves required functionality
Reduces unplanned downtime
Requires investment

Corrective Maintenance (CM)
Unscheduled
Reactive Maintenance

Repairs or corrective actions
Run to failure
Failure has occurred

Fixes failures in unplanned manner
Downtime unpredictable
Addresses only “what’s broken”

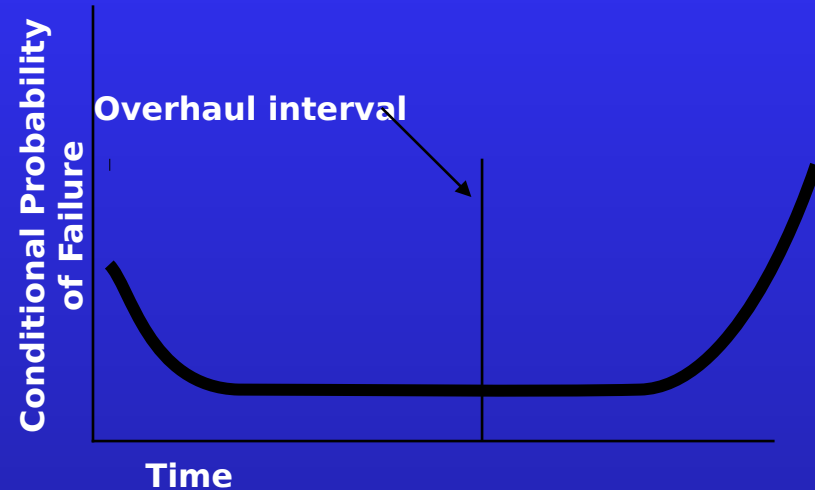
History of RCM

HOW DID RCM COME ABOUT?

- Early PM assumed periodic overhauls ensured reliability and safety
- Commercial airlines questioned reliance on overhauls in 1960's due to rising costs, without more reliability
- FAA and airlines established "Maintenance Steering Group (MSG)" to investigate/recommend new approaches
- MSG logic developed and first applied to Boeing 747

History of RCM

**OVERHAUL
PHILOSOPHY
ASSUMES THIS
IS TRUE . . .**



What the airlines discovered

- Statistical analysis often showed no change in safety or reliability when overhaul limits changed...sometimes worsened
- Overhaul limits were usually not analytically based
- Overhauls generate high repair costs for little or no benefits

Facts about overhauls

- Many failure modes do not support overhaul philosophy - have no "wear out" characteristic
- Considerable component life sacrificed
- Overhauls introduce infant mortality failures

History of RCM

Failure Distributions of Typical Aerospace Components

UAL 1968 Broberg 1973 MSP 1982

4% 3% 3%

2% 1% 17%

5% 4% 3%

Ranges
from 8%
to 23%

7% 11% 6%

14% 15% 42%

68% 66% 29%

Ranges
from 77%
to 92%

History of RCM

Inspections **Alternatives to Overhaul-based Maintenance**

- Looking for “**potential failure**” condition
- Leaves item in-service for most of its useful life

“Fly to failure”

- When consequences are severe - not an option
- When consequences are acceptable - “fly to failure” may be best approach for cost/mission

MSG (later coined RCM) applied the most appropriate maintenance philosophy to each failure mode based on data/information

History of RCM

1965: Studies show scheduled overhaul of complex equipment has little or no effect on in-service reliability

1967-68: Airline and manufactures form Maintenance Steering Group (MSG) and produce **MSG 1**, “ Handbook: Maintenance Evaluation and Program Development.”
First applied to Boeing 747

1970: MSG handbook updated to **MSG-2**, “Airline/Manufactures Maintenance Program Planning Document”. Applied to L-1011 and DC-10

1972: MSG-2 techniques applied to NAVAIR systems (P-3A, S-3A, and F-4J)

History of RCM

1975: NAVAIR applied Analytical Maintenance Program to Naval aircraft and engine programs, using MSG-2 type logic (**NAVAIR 00-25-400**)

1978: Department of Defense (DOD) sponsored DOD report **AD-A066579**, “Reliability Centered Maintenance” by Nowlan and Heap - Updates MSG-2 approach with better guidance on process and interval determination

1980: Army issued **Army Pamphlet 750-40**, “Guide to RCM for Fielded Equipment ”

1981: DOD issued **MIL-HDBK-266**, “Application of RCM to Naval Aircraft, Weapon Systems and Support Equipment” to implement RCM concepts from DOD report AD-A066579

History of RCM

1983: MSG-3 issued. Used in design of Boeing 757 and 767 aircraft. Added emphasis on structural inspection programs. Similar to RCM, but lacked guidance on interval determination

1985: US Air Force (USAF) issued MIL-STD-1843, "RCM Requirements for Aircraft, Engines and Equipment" - Similar to MSG-3 (Cancelled without replacement in 1995, USAF Instructions contain current policy/guidance)

1986: NAVAIR issued MIL-STD-2173, "RCM Requirements for Naval Aircraft, Weapons Systems and Support Equipment". Superseded MIL-HDBK-266 & NAVAIR 00-25-400

➤ NAVAIR 0-25-403 issued containing Age Exploration guidance.

1992: Coast Guard issued CGTO PG-85-00-30, "Aeronautical Engineering Process Guide for RCM Process"

History of RCM

1996: NAVAIR updated **NAVAIR 00-25-403** to contain complete RCM process due to cancellation of MIL-SPEC's

1999: SOCIETY OF AUTOMOTIVE ENGINEERS (SAE) issued **SAE JA1011**, "Evaluation Criteria for RCM Processes" - establishes criteria for RCM processes (NAVAIR and Aladon/John Moubray major contributors)

2001: NAVY updated **NAVAIR 00-25-403** to capture improvements developed during SAE JA1011 work - provides primary guidance for implementing NAVAIR RCM program or performing RCM analysis (Current edition March 2003)

2002: SAE issued **SAE JA1012**, "A Guide to the RCM Standard" - amplifies and clarifies key concepts and terms from SAE JA1011

History of RCM

- RCM success in Aviation industry noted by other industries - Nuclear Power industry adopts approach due to focus on avoiding “**safety consequences**” while reducing costs
- “RCM II” by John Moubray published in UK in 1990
- “Reliability-Centered Maintenance” by Mac Smith published in US in 1993
- As interest in increased, a variety of other processes called themselves “RCM”

Industry interest in SAE JA1011 and JA1012 was to identify “valid” RCM approaches

History of RCM

SAE JA1011 “Evaluation Criteria for RCM Processes” defines seven questions for RCM:

- What are the functions...of the asset...(functions)?
- In what ways can it fail...(functional failures)?
- What causes each functional failure (failure modes)?
- What happens when each failure occurs (failure effects)?
- In what way does each failure matter (failure consequences)?
- What should be done...(proactive tasks and intervals)?
- What should be done if a suitable proactive task cannot be found?

Also requires a “Living Program”

History of RCM

NAVAIR RCM

NAVAIR 00-25-403 satisfies **SAE JA1011**

- Built on FMECA and Failure Consequence determinations (**questions 1 through 5**)
- Establishes task and interval evaluation process (**question 6**)
- Considers “other actions” and “No PM” (**question 7**)
- Requires RCM Sustainment and Age Exploration (**Living Program**)

RCM Policy

NAVAIR 00-25-403 RCM process:

- Evolved over nearly 30 years
- Used in on a variety of equipment in various applications
- Continuously improved
 - ✓ **NAVAIR RCM Steering Committee**
- Complies with **SAE JA1011**
- **Public Domain**

RCM Policy

- **NAVAIRINST 4790.20, *Reliability-Centered Maintenance Program***

Defines NAVAIR's RCM Program policy and responsibilities

- **AIR-00 Ltr, "A Logistics" 24 L**

Outlines AIR-00's intention and directions for RCM based Integrated Maintenance Concept (IMC)

- **AIR-3.0/4.0 Ltr, "Maintenance"**

- **NAVAIR RCM St (approved by 3**

reiterating AIR-00 commitment to RCM

- **DoD Guide for Supportability, Enterprise, and**

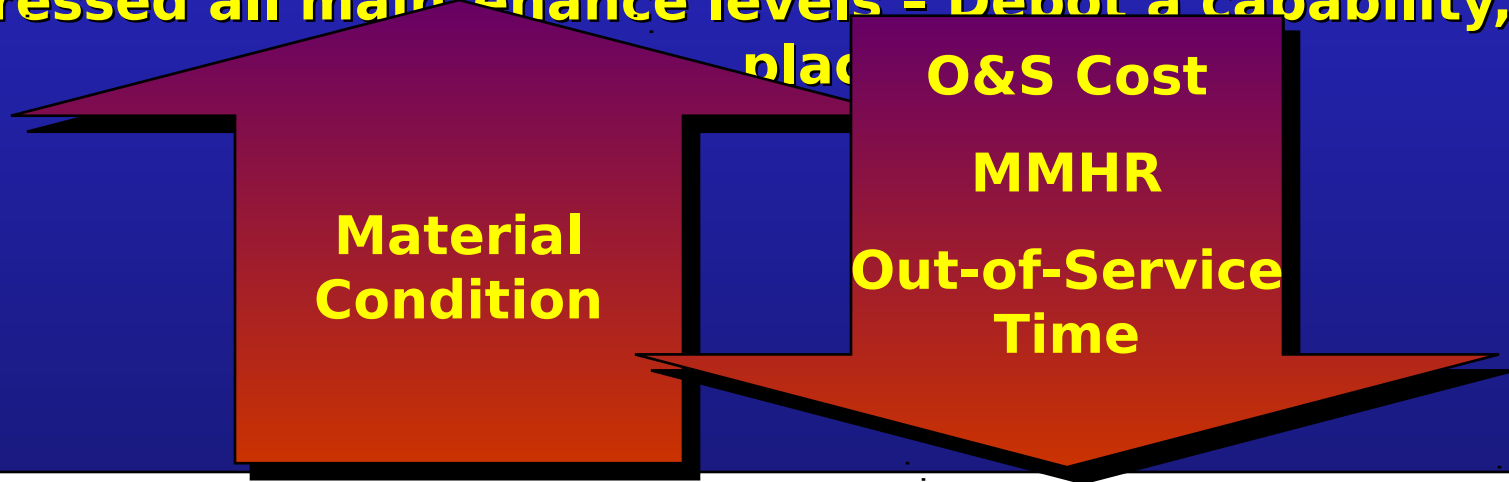
Established leadership and guidance committee for NAVAIR RCM within 3.0

Emphasizes RCM as a critical Life Cycle Process

Integrated Maintenance Concept (IMC)

- Derived from RCM Successes on AV-8B, T-45 and E-6 programs
- Resulted from CNO direction to eliminate ASPA program and establish fixed periods
- Focuses on performing RCM driven requirements at optimal locations with appropriate skills

Addressed all maintenance levels - Denot a capability, not a place

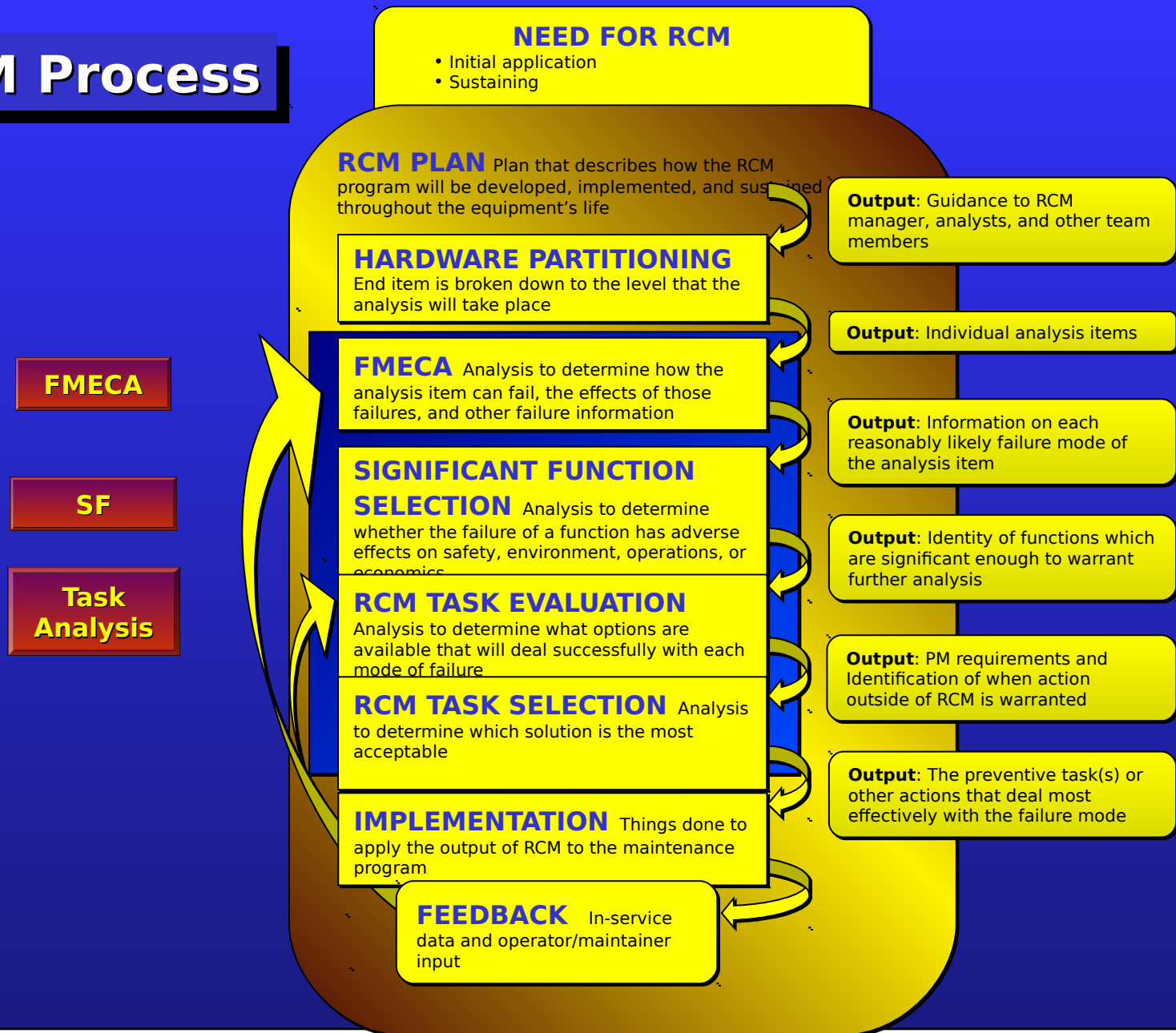


RCM Guidance

NAVAIR 00-25-403 provides guidance on:

- RCM planning and preparation
- RCM training and certification
- FMECA development
- RCM analysis process
- Implementing analysis results
- Sustaining the resulting maintenance program
- Assessing RCM Effectiveness
- Related issues:
 - ✓ Prognosis and Health Monitoring Systems
 - ✓ RCM Plans
 - ✓ RCM quantitative methods

RCM Process



Is the functional failure or effect of the failure mode, on its own, evident to the operator while performing normal duties?

**YES
Evident**

Does failure mode cause a function loss or secondary damage that could have an adverse effect on operating safety or lead to serious environmental violation?

**YES
Evident
Safety/
Environment**

**Analyze
Options:
S, L, OC, HT,
Other Action**

**NO
Evident
Economic/
Operational**

**Analyze
Options:
S, L, OC, HT,
No PM,
Other Action**

**NO
Hidden**

Does hidden failure mode in combination with second failure/event cause function loss or secondary damage that could have an adverse effect on operating safety or lead to serious environmental violation?

**NO
Hidden
Economic/
Operational**

**Analyze Options:
S, L, OC, HT, FF,
No PM,
Other Action**

**YES
Hidden
Safety/
Environment**

**Analyze
Options:
S, L, OC, HT, FF,
Other Action**

Select BEST OPTION

RCM PM Tasks

Servicing:

The replenishment of consumable materials that are depleted during normal operations.

RCM PM Tasks

Lubrication:

The scheduled lubrication of a component (usually based on the manufacture's recommendations) where the item's design requires a non-permanent lubricant for proper operation

RCM PM Tasks

On-Condition

Periodic or continuous inspection designed to detect a potential failure condition prior to functional failure.



RCM PM Tasks

Hard Time Task:

Scheduled removal of an item or a restorative action at some specified age limit to prevent its functional failure.



RCM PM Tasks

Failure Finding:

A preventive maintenance task performed at a specified interval to determine whether a hidden functional failure has occurred.

RCM Other Actions

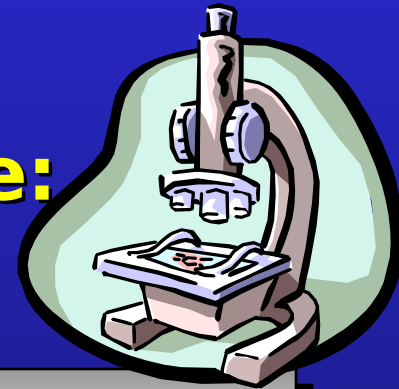
Usually a one time action, other than PM, that effectively reduces consequences of failure or resolves problems identified during the conduct of the analysis

Examples:

- ✓ *Item redesign*
- ✓ *Change in an operational or maintenance procedure*
- ✓ *Operating restrictions*
- ✓ *Training*
- ✓ *Publications*
- ✓ *Technology insertion*

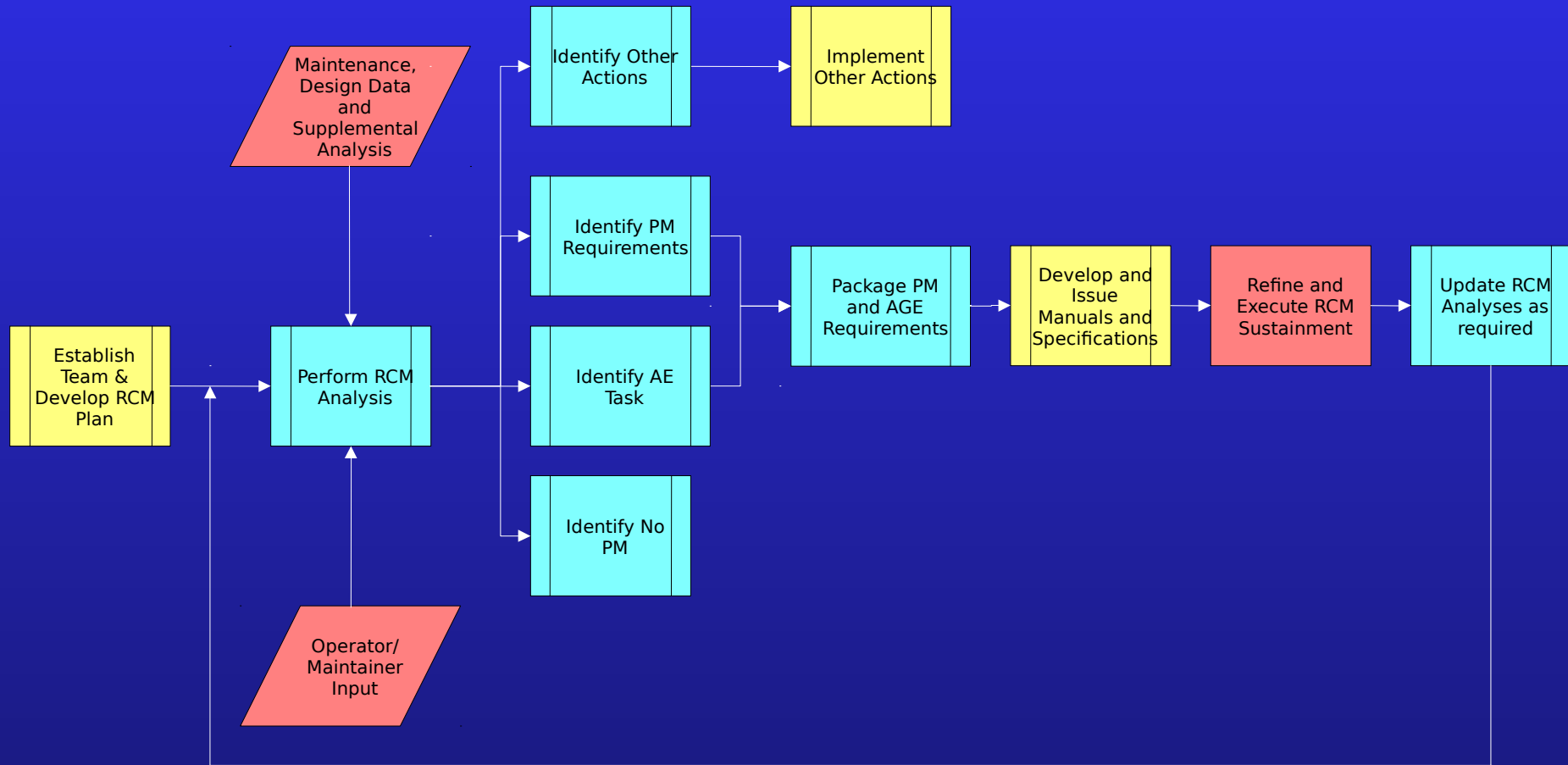
Age Exploration Tasks

- **Specific tasks to collect data to:**
 - ✓ Refine RCM analysis assumptions and data
 - ✓ Optimize PM tasks
- **Age Exploration tasks are targeted to specific failure modes and data shortfalls**
- **Age Exploration tasks may be:**
 - ✓ in-service inspections or tests
 - ✓ laboratory tests and studies
 - ✓ data analysis



For safety consequence failure modes, Age Exploration must not expose operators to unacceptable risk of failure

RCM Process



RCM in Acquisition

Concept & Technology Development:

- “Functionally” oriented, to establish design targets, maintenance strategies, and trade-off processes
- Identify potentially beneficial technologies and tools
- Establish team roles and responsibilities

System Development & Demonstration

- Conduct Baseline Comparison Study for targets of opportunity
- Conduct Use Study for design constraints
- Refine RCM Plan with detailed ground rules, metrics, trade study processes, team composition and roles
- Seek lessons learned for application to design

Production & Deployment

- Update analyses and plans of prior phases, define RCM sustainment processes and resource requirements
- Conduct “hardware” analyses of evolving design to influence design and establish final failure management strategies
- Package, implement and monitor PM and AE requirements

Operations & Support

- Implement RCM sustainment process

RCM Tools

➤ Integrated Reliability-Centered Maintenance System

- ✓ Facilitates and documents analyses
- ✓ Provides audit trail, historical record, and benefits analysis in a relational database format
- ✓ Public domain and NMCI approved

➤ Task Analysis Worksheet

- ✓ Facilitates MTBF, task interval and cost avoidance determinations

Available via NAVAIR RCM website for download



RCM Tools

IRCMS

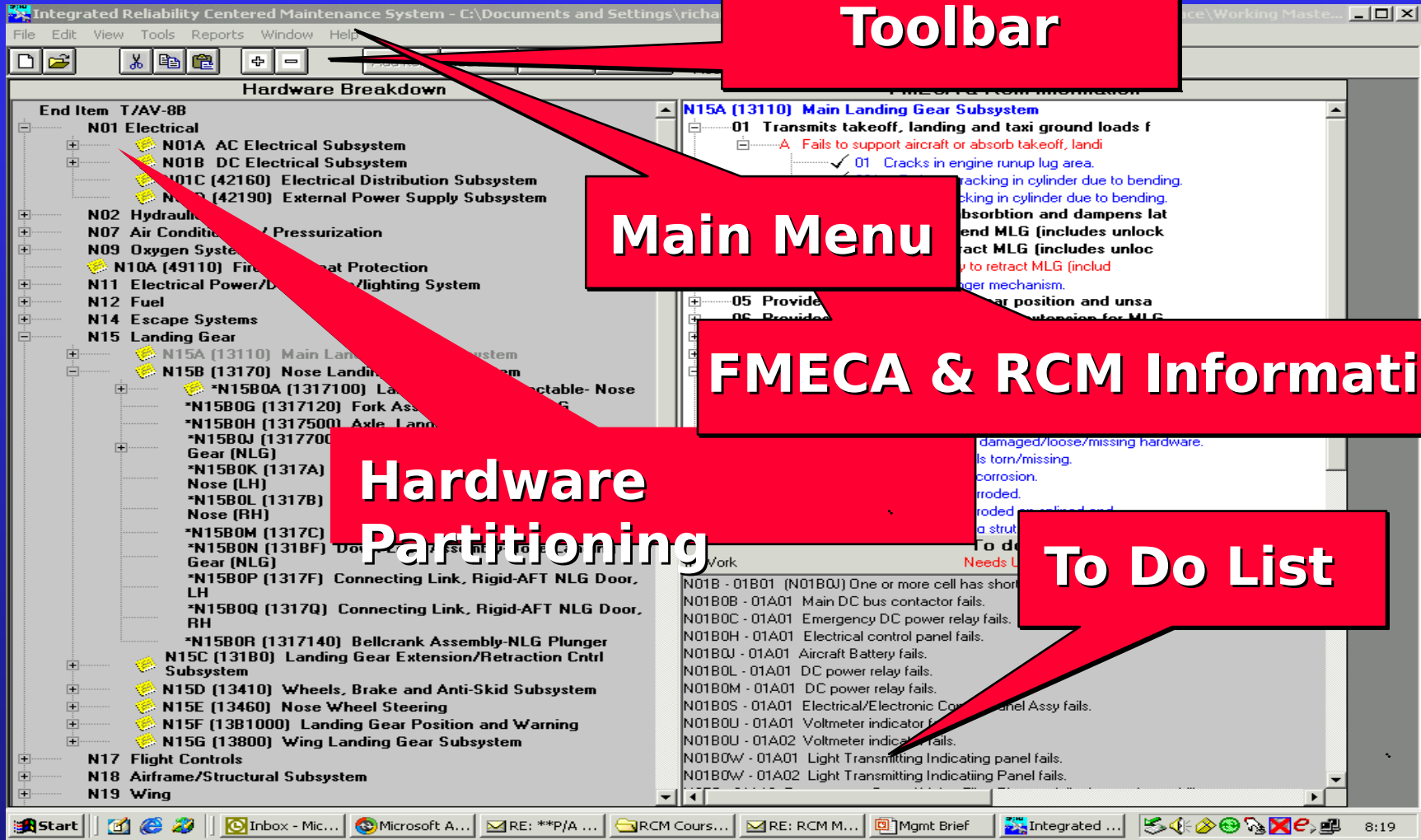
Toolbar

Main Menu

FMECA & RCM Information

Hardware Partitioning

To Do List



Integrated Reliability Centered Maintenance System - C:\Documents and Settings\richard.d.hoffman\My Documents\DATA\Old D Drive\RAF Interface\Working Master...

File Edit View Tools Reports Window Help

Current User: Mock
Access Level: Approver

Hardware Browser

End Item T/AV-8B

N01 Electrical

N01A AC Electrical Subsystem

N01B DC Electrical Subsystem

N01C (42160) Electrical Distribution

N01D (42190) External Power

N02 Hydraulic

N07 Air Conditioning

N09 Oxygen

N10A

N11 Electrical

N12 Fuel

N14 Escape

N15 Landing Gear

N15A0A (1311100) Redundant

N15A0B (13118B) Hydraulic Tank (Recuperator)

N15A0D (13117) Main Landing Gear Assembly

N15A0E (13118) Main Landing Gear Assembly

N15A0F (1311E) Main Landing Gear Assembly

N15A0G (1311G) Main Landing Gear Assembly

N15A0H (1311J) Forward Landing Gear Assembly

N15A0J (1311C) Main Landing Gear Assembly

N15A0K (131B4) Air-Fluid

N15A0L (131B3) Fluid Power

N15B (13170) Nose Landing Gear

*N15B0A (1317100) Landing gear, retractable- Nose

*N15B0G (1317120) Fork Assembly, Wheel, NLG

*N15B0H (1317500) Axle, Landing Gear-Nose

*N15B0J (1317700) Shock Absorber Unit, Nose Landing Gear (NLG)

*N15B0K (1317A) Door, Landing Gear, Aircraft- FWD Nose (LH)

*N15B0L (1317B) Door, Landing Gear, Aircraft-FWD, Nose (RH)

*N15B0M (1317C) Door, Landing Gear, Aircraft-AFT, Nose

*N15B0N (131BF) Down Lock Assembly-Nose Landing Gear (NLG)

*N15B0P (1317F) Connecting Link, Rigid-AFT NLG Door, LH

Failure Mode - N15A (13110) - 01A03

Item ID: N15A (13110) Main Landing Gear Subsystem FMI: 01 - A - 03 Rev: A

Failure Mode Description:

"Fatigue cracking in cylinder due to bending.

"Fatigue cracking in cylinder due to bending.

Operator/Aircraft

Severity Class: MTBF

315120 Hours

WOL of failed item: 131111

Effectivity: All T/AV-8B

Part No. of failed item: 200887229/131111

Mission Phase:

Failure Mode* Failure Consequences Service/Lube* On-condition* Hard-time*

Failure Finding* Age Expiration* Other Action Cost Analysis* Package / Summary*

Save Continue Cancel Memo

8:22

TASKS

FAILURE MODE

RCM Tools

Microsoft Excel - RCM Task Interval Worksheets 2003d_TEST

File Edit View Insert Format Tools Data Window Help

F35

For proper use of this spreadsheet, refer to NAVAIR 00-25-403 section 3.5.5 and Appendix B section 1.2

Enter Part Name:

	Value	Units
MTBF:	1	Flight Hours
Valent MTBF:	1	Flight Hours
PF Interval:	1	Flight Hours
Preventive task:	\$30.00	
Inspection:	1.00	
Maintenance:	O-Level	
Repairable(s) cost:	\$0.00	
One potential failure:	\$30.00	
One potential failure:	1.00	
Maintenance:	O-Level	
Material cost:	\$0.00	
Cost of correcting one potential failure:	\$60.00	
Hours to correct one potential failure:	1.00	
Level of Maintenance:	D-Level	
Cost of replacement and/or repaired parts:	\$0.00	
Costs associated with lost operational time due to failure:	\$0.00	
Probability of detecting the failure in one inspection:	30%	

Leave blank unless other than default values above:

Initial Task Interval is: 1.00 Flight Hours

MEASUREMENT BASE

- Days
- Months
- Years
- Flight Hours
- Flights
- Engine Operating Hours
- Arrestments

HOME

50%

Enter other value below

Number of inspections (n) in PF interval for calculated task interval: 1.000

Cost per flight hour with inspection in place at initial task interval: \$63.00

Cost per flight hour with no PM: \$60.00

Minimum PF Interval to achieve a cost effective task: 1 Flight Hours

Note: Hourly Cost of Maintenance at O and I Level = \$30.00
Hourly Cost of Maintenance at D Level = \$60.00

Calculated n less than 1 results in Initial Task Interval (cell B25) being same as PF Interval (cell B8)
To have a cost effective task, ensure that this cost is less than cost of no PM (cell B29)

Costs should be based on future projections, not just a single gear labor rate.

Ready Calculate

Start

Inbox - ...

WinZip - ...

Interval (Existing Task) H

NUM

14:41

Recommended
Task Interval

Task Analysis
Worksheet

Failure Mode Data

Cost Analysis

RCM Tools

RCM Web Site: <http://logistics.navair.navy.mil/rcm>

Contains:

- **NAVAIR 00-25-403 & Other guidance**
- **IRCMS software for download**
- **Training Material and Course Schedules**
- **RCM Steering Committee Info**
- **Link to Intranet RCM site at NADEP JAX**
 - ✓ *RCM Interval Worksheet*
 - ✓ *Analysis Examples*
 - ✓ *RCM Steering Committee meetings*
 - ✓ *POC's*
 - ✓ *Internet Links*

RCM Examples

EA-6B Prowler Aircraft

➤ Aircraft Inspections

4 A/ C Squadron over 2 Years									
Pre RCM					After RCM				
Interval	Mhrs	Total Mhrs	TAT	Total TAT	Interval	Mhrs	Total Mhrs	TAT	Total TAT
14 Days	26	2704	0.5	52	14 Days	26	2704	0.5	52
28 Days	93	4836	3	156	28 Days	14	728	0.5	26
56 Days	126	6552	5	260	56 Days	11	572	0.5	26
224 Day	194	2328	5	60	364 Day	200	1600	5	40
ASPA	6	30	2	16	IMCF	109	436	14	56
Annual MHRS		16450		492	Annual MHRS		6040		148
Delta							-10410		-344
106 A/ C over 2 Years									
Pre IMC					IMC				
Interval	Mhrs	Total Mhrs	TAT	Total TAT	Interval	Mhrs	Total Mhrs	TAT	Total TAT
14 Days	26	71656	0.5	1378	14 Days	26	71656	0.5	1378
28 Days	93	128154	3	4134	28 Days	14	19292	0.5	689
56 Days	126	173628	5	6890	56 Days	11	15158	0.5	689
224 Day	194	61692	5	1590	364 Day	200	42400	5	1060
ASPA	6	795	2	424	IMCF	109	11554	14	1484
Annual MHRS		435925		13038	Annual MHRS		160060		3922
Delta							-275865		-9116

RCM Examples

Example: EA-6B Prowler Aircraft

- Landing gear Example
- Fixed OH interval (10 years) vice OH with A/C depot induction
 - ◆ Depot induction intervals varied (ASPA at the time)
 - ◆ Landing gear move between A/C

SDLM				SRC				Savings
L	R	Total	Cost	L	R	Total	Cost	
13	13	26	\$1,283,535	4	1	5	\$316,854	\$ 966,681
10	10	20	\$989,380	9	7	16	\$924,772	\$ 64,607
15	15	30	\$1,479,638	3	3	6	\$339,483	\$ 1,140,155
15	15	30	\$1,479,638	9	7	16	\$924,772	\$ 554,866
15	15	30	\$1,479,638	4	4	8	\$452,054	\$ 1,027,585
5 year Savings								\$ 3,753,894

Requirements for RCM Success

➤ **Management commitment**

- ✓ Dedication and resources for analysis and implementation
- ✓ A designated “champion” (Implementation Manager)
- ✓ Training and mentoring
- ✓ Ensuring RCM-supported failure management strategies (avoid unsupported directives)

➤ **Organizational “Buy-in”**

- ✓ Support at all levels
- ✓ Involvement of Engineering, Logistics, Maintenance and Operations

➤ **Planning**

- ✓ Early RCM Plan and execution strategy

➤ **Communication**

Requirements for RCM Success

➤ Data and Information

- ✓ Acceptable performance levels
- ✓ Compensating Provisions
- ✓ Detection Methods (Operations and Maintenance)
- ✓ Failure Mode Characteristics
 - Precursors to failure
 - Potential to Functional Failure Interval
 - Crack Growth (Damage Tolerance Analysis)
 - Flaw growth (composites and non-structural)
 - Fatigue Design Life/Wear-out modes
 - Probability of Failure
- ✓ In-service Serial Number Tracking
- ✓ Maintenance Actions (problem report to final repair)
- ✓ Costs
- ✓ Downtime, operational impacts

➤ Early “Wins”

- ✓ Success breeds Success, prioritize application to first focus on areas with greatest potential for improvement

Pitfalls

- **Avoid dependence on 3-M data**
 - ✓ Establish relations with operators and maintainers
 - ✓ Use quality over quantity
 - Engineering investigation and test data
 - Known serialized-item data vice general population data
- **Avoid reliance on “design FMECA”**
 - ✓ Use FMECA at sub-system level, or “roll-up” design FMECA
 - ✓ Ensure in-service findings incorporated
- **Ensure Subject Matter Experts available**
 - ✓ FST Engineers often most knowledgeable
- **Don't oversell, ensure committed to long run**
 - ✓ RCM develops best “failure management policy”, benefits depend on state of current policies
 - ✓ Biggest RCM benefit often in long term strategy and sustainment
 - ✓ Ensure scope and expectations in sync with resources and commitment

NAVAIR RCM Responsibilities

➤ **NAVAIR RCM Steering Committee:**

- ✓ **Provide technical assistance**
- ✓ **Review RCM Program Plans**
- ✓ **Assist AIR 3.1/3.2 in review and performance evaluations of activities responsible for performing and sustaining RCM analyses,**
- ✓ **Coordinate with AIR 3.3 to develop, distribute, maintain, and update the IRCMS software.**
- ✓ **Coordinate training and certification requirements**
- ✓ **Maintain and disseminate knowledge of advancements in technologies and processes among other services, industry, and academia**

NAVAIR RCM Responsibilities

- **System Integrated Logistics Support (SILS) personnel (DOL/APML/PSTL/IPT Leads):**
 - ✓ Approve RCM Program Plans
 - ✓ Ensure RCM programs are adequately addressed in budget submittals
 - ✓ Ensure RCM programs are integrated with cost-wise readiness strategies
 - ✓ Ensure identification and implementation of ILS requirements to sustain PM tasks
 - ✓ Ensure any RCM and Age Exploration (AE) efforts comply with NA 00-25-403.

NAVAIR RCM Responsibilities

➤ **FSTs and IPTs:**

- ✓ **Develop and execute RCM Program Plans**
- ✓ **Ensure technical directives, documentation, and specifications are supported by RCM analysis**
- ✓ **Establish Operational Service Period (OSP), Fixed Induction Date (FID), Period End Date (PED), Maximum Operating Time (MOT), Serviceable In-service Time (SIST) (or equivalent) recommendations using pertinent RCM data**
- ✓ **Ensure coordination of logistics support requirements generated from modified PM tasks**
- ✓ **Coordinate structural life limit changes with the Air Vehicle Department (AIR 4.3)**

NAVAIR RCM Responsibilities

➤ **NAVAIR Competency Managers:**

- ✓ Ensure assigned RCM personnel are trained and certified

➤ **NAVAIR Logistics Policy, Process and Assessment Office (AIR 3.0E):**

- ✓ Provide overall management for RCM Program policy and procedures.

➤ **Program Managers Air (PMAs):**

- ✓ Plan and budget for RCM throughout the life cycle
- ✓ Acquire RCM data for new equipment and updates/redesign/modifications to existing equipment
- ✓ Ensure failure management strategies are supported by RCM, including commercial support

NAVAIR RCM Responsibilities

- **Assistant Commander for Research and Engineering (AIR 4.0):**
 - ✓ Ensure PM requirements for life-limited items are consistent with RCM
 - ✓ Ensure adequate Failure Modes and Effects Analysis (FMEA) and reliability, maintainability, structural fatigue, system safety, and other engineering data during the acquisition, sustainment, and modification processes

RCM Certification

Certification ensures qualified individuals for RCM

Categories of certification are:

- Level 1 - indicates an individual has received a Naval Air Systems Command (NAVAIR) approved RCM Analyst course and is familiar with contents of NA-00-25-403
- Level 2 - indicates an individual is capable of leading or conducting an analysis effort.
- Level 3 - indicates an individual is well versed, trained, and experienced in RCM methods and applications. A Level 3 RCM Analyst may serve as an Implementation Manager for a RCM program or extensive analysis effort.

Certification requirements are addressed in NA-00-25-403

RCM Sustainment

➤ **The sustainment process must continually monitor and optimize the failure management strategy by:**

- ✓ Deleting unnecessary requirements or adjusting intervals
- ✓ Identifying adverse failure trends
- ✓ Addressing new Failure Modes
- ✓ Pursuing opportunities for insertion of new maintenance procedures, techniques, design changes, and tools

➤ **Sustainment methods include:**

- ✓ Emergent issue resolution
- ✓ Root cause analysis
- ✓ Degradation analysis
- ✓ Trend analysis
- ✓ Fleet reviews

RCM in a Nut Shell

➤ In summary, RCM asks:

- ✓ What does an item do?
- ✓ How does it do it?
- ✓ How does it fail?
- ✓ What happens when it fails?
- ✓ Can the failure be prevented or mitigated?
- ✓ Is there value in preventing or mitigating the failure?
- ✓ Does in-service data indicate changes or improvement are needed?



**Safety, environmental hazards, operations,
and economic impacts are put into balance**